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DEVICE FOR THE HYGROMETRIC REGULATION OF AN ENCLOSURE

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DEVICE FOR THE HYGROMETRIC REGULATION OF AN ENCLOSURE

[Dispositif pour la regulation hygrométrique d'une enceinte]

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The present invention concerns a device which makes it possible to ensure a regulation of the level of humidification, at a point close to saturation, of an air-conditioned enclosure.

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More specifically, the invention concerns enclosures such as chambers or cabinets whose atmosphere is conditioned as far as temperature goes, hygrometry (and optionally pressure) to ensure the treatment of agro-food products.

In numerous circumstances, on the occasion of a specific phase in their treatment, agro-food products must undergo a process whose phases require the precise maintenance of parameters, notably temperature and hygrometry.

Under these conditions, such products are maintained in a closed enclosure whose atmosphere is controlled as far as humidity and temperature is concerned, in predetermined cycles.

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\* [Numbers in the right margin indicate pagination of the original foreign text.]

This is notably the case for bread products whose preparation today is integrated in a cycle which frequently comprises an industrial phase, and where the products are frequently exposed to a preservation phase in the frozen state and then delivered in this state to the final processor.

At the level of the transformation of the product to achieve its final state where it constitutes a marketed product suitable for consumption, the lots of product, notably bread products, must undergo a complex cycle to ensure, in a first step, the maintenance of their frozen state for a time necessary to constitute a backup reservoir, and then a thawing phase according to a predetermined cycle, followed by a rest phase and then a fermentation phase to obtain a leavened product, which is available for the final cooking face [sic; phase].

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The different steps assume that the product is kept in one or more successive enclosures whose temperature and especially hygrometric level will be strictly controlled.

More specifically, in most cases the level of humidity will have to be maintained at a point close to the saturation point, independently of the thermal cycle.

However, it is difficult to maintain a constant level of humidity, notably one that is close to the saturation degree, while the thermal cycle follows an independent curve.

Indeed, it is clear that the saturation point varies as a function of the temperature.

Devices are known which are intended to contribute humidity in the form of vapor which is produced from hot water, and optionally from water which is close to the boiling temperature; however, the contribution of humidity in the form of hot vapor interferes with the thermal cycle which is now difficult to control; in addition, when the hot vapor is introduced into a enclosure, for example during heating, while the walls or the composition of the products is still at a temperature much below ambient temperature, the introduction of hot vapor rapidly causes condensation on the product and the formation of a superficial layer of water in the liquid phase; in fact, the products have to be able to breathe, and therefore the water should remain in the vapor phase.

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Under these conditions it is difficult to obtain a device which ensures a regulated humidification at all periods of the thermal cycle, both during cold and hot periods, where the humidity is constantly maintained at the point which is close to the saturation point without generating condensation on the products from the hot vapor which is brought in contact with the still cold products.

From French Patent No. 73 30 691, filed in the name of the applicants, a device is known which is integrated into a storage cabinet with climate control, in which the humidity is maintained by the placement of a storage phase at this humidity, which consists of horizontal vanes which are capable of absorbing, by condensation to their surface, the humidity exuded from products (notably bread products before cooking, such as shaped dough pieces), where this

humidity is then returned to the internal atmosphere at the time of the change to the hot phase by heating of the ambient air.

However, while this device is useful and effective in the context of a programmed fermentation chamber, it does not meet all the needs encountered in the steps of processing products which are delivered in the deep frozen state.

Indeed, in the case where the shaped dough pieces are introduced in the fresh state into the fermentation chamber, [given] the humidity which they contain internally and which rapidly fills the atmosphere due to the large exchange surface area presented by the shaped dough pieces, it is sufficient to contribute humidity during the saturation of the atmosphere, which is initially maintained in a cold phase to inhibit fermentation; the humidity released by the shaped dough pieces is adsorbed by the storage device consisting of the horizontal vanes and then returned during the temperature increase phase corresponding to the fermentation period. /4

However, if the products are introduced in the enclosure in the deep frozen state, that is at a temperature in which the water which they contain is retained in the solid state inside the composition of the products, no notable amount of humidity, that originates from the food products in the deep frozen state, is released into the enclosure; and it may be necessary, as a function of the desired cycle (temperature humidity), (to successively cause thawing, preservation at low temperature, and then fermentation), to contribute humidity from the outside.

French Patent No. 84 02 778 addresses this and it makes it possible to provide a source of humidity in a conditioning enclosure, for the storage and the fermentation of bread products; the humidity which is made available to regulate the hygrometry of the internal atmosphere of the enclosure according to the patent 84 02778 presents the advantage of being dispersed at ambient temperature; in this manner the contribution of humidity is in fact independent of all thermal contribution, the humidity being delivered into the enclosure in the form of steam at the temperature of the internal volume of the enclosure, and consequently there is no risk of contributing calories which would be a source of perturbation of the thermal cycle, nor is there a risk of interference condensation on the surface of the products.

For this purpose, French Patent No. 84 02 778 provides a succession of water receiving trays which are arranged in shelves one above the other, with slow flowing circulation out of one tray into the other. /5

The present invention achieves an improvement of the device known from the French Patent Nos. 73 30691 and 84 02778.

Indeed, in the device according to the present invention, one can achieve the contribution of external humidity, which is delivered and made available inside the enclosure at the ambient temperature prevailing in this enclosure, without contributing any interfering calories.

Nevertheless, the device according to the present invention makes it possible to use the devices for dispersion of heat and/or cold, which consists of the vanes in association with the circulation of the heating or refrigerant fluid, depending on the phases of the cycle used.

Notably, in the context of the present invention, the same device can be used to simultaneously:

- ensure refrigeration of the atmosphere
- ensure, at a given moment, the heating of this atmosphere (for example by the fermentation of the products)
- and, also ensure the humidity regulation without interference with the thermal regulation.

The same assembly, when it is integrated in the conditioning enclosure, will thus make it possible to ensure the thermal cycle as well as the humidity cycle.

To this effect, the invention concerns a device to ensure the humidification of the internal atmosphere of an enclosure whose temperature can vary between a level corresponding to a freezing temperature of the products and a temperature above ambient temperature, and the device is characterized in that it comprises horizontal blades in a shelf-like arrangement along at least a part of a wall of said enclosure, where the blades are associated with an external water supply source which can cover said blades with a layer of water in the liquid state, where each one the layers comprises a means allowing excess water on said blade to flow by gravity toward to the blade immediately below.

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It is preferred for the blades to consist of steel or aluminum sheet metal, for example.

According to another special feature, the blades constitute vanes for dispersion of heat and/or cold; they are associated with a coil for the circulation of heating or cooling fluid, which is connected to a heat and/or cold source.

According to another characteristic, the blades are substantially flat and they are arranged in a substantially horizontal plane, and each blade comprises a point-shaped zone of discontinuity in the surface evenness, where this zone constitutes the means allowing excess water to flow by gravity onto the lower blade.

For example, said zone of discontinuity consists of a break in continuity, such as a perforation or a recess in the surface of the blade, which can cause the water to flow downward.

According to another embodiment, said zone of discontinuity consists of a given downward inclination or slope to the edge of said blade, causing excess humidity to flow by gravity toward the lower blade.

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According to a special characteristic, said blade is subjected to a surface treatment which can adjust the liquid/solid surface tension between the water which has flowed and wall of the blade constituting the support receiving the circulating water.

It is preferred for the device to consist of a horizontal superposition of blades in a shelf-like arrangement at the bottom of the wall of the enclosure; the resulting device is associated with a means for circulating ambient air such that this air is caused to regularly and constantly lap against the walls of said blades which receive the layer of water, entraining the water into the atmosphere as it evaporates.

According to another characteristic, the device is associated with a water source which is connected to an external supply, for example to the water supply of the city, and led to a flow vat placed above the upper blade.

The device comprises, in the low position, a receiving vat, which is located immediately below the lowest blade and capable of receiving the overflow of the device.

According to another characteristic, the upper supply source comprises an electro-valve with programmable action.

It is preferred for the electro-valve to be associated with a central control means, itself associated with a probe which is capable of permanently measuring the hygrometry of the internal atmosphere of the enclosure and of sending orders to open the electro-valve as a function of the observed humidity requirements.

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According to another characteristic, said blades present uneven relief of their horizontal wall whose hollow face is turned upward, where the hollows can constitute water reserves on the surface of said blades.

Other characteristics and advantages of the invention will become apparent in the description given below with reference to special embodiments.

Figure 1 represents a schematic cross section of the device according to the invention, installed in an air-conditioned enclosure for the treatment of agro-food products, such as shaped dough pieces or bread products.

Figure 2 represents a perspective detail view of the blades for spreading and distributing the humidity according to the invention.

Figure 3 represents a schematic view with frontal elevation of the device according to the invention, showing the distribution of the humidification fluid.

Figure 4 represents a view identical to that of Figure 3 except for an embodiment variant of the humidification blades.

According to Figures 1 and 2, one can see that the device consists of horizontal blades 1, 2, 3, 4 which also constitute surfaces with loss of heat or cold due to the coil, whose elements 5, 6, 7 and 8 are vertically arranged and associated with the blade constituting the cooling/heating vanes.

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The device which is represented in a partial and enlarged view in Figure 2, is placed, for example, close to the bottom 9 of the conditioning enclosure 10 (Figure 1).

The enclosure 10 comprises shelves or refrigerator shelves 11, 12, 13, 14 which are arranged in a shelf-like arrangement to allow the storage of food products, for example shaped dough pieces or bread products 15, 16, 17, 18.

The enclosure 10 can be programmed for a specific use or as a function of the thermal cycles made possible by the refrigeration/cooling system; it can be adapted to any succession of programmed operations including thawing, rest, fermentation, etc.

During the course of these operations, the temperature can be controlled by two combined means, heating and cooling, respectively; the cooling means is assumed to consist of the coil whose vertical parts 5, 6, 7 and 8 are represented in the figure, and the coil is connected in a known manner to a compressor capable of causing the circulation of the coolant liquid in the coil, where dispersion and loss of cold are achieved at the level of the blades or vanes 1, 2, 3 and 4.

The heat source can consist of a heating resistance, optionally incorporated or associated with the lower blower 19. /10

However, one can optionally provide for this coil to be supplied by a single heating/refrigeration assembly, in such a manner that the fluid circulating in the coil (that is in the vertical elements 5, 6, 7 and 8) is successively adjusted to appropriate negative or positive temperatures as a function of the desired thermal cycle, and this cycle is programmed by means which in themselves are known.

The vanes consisting of blades or metal sheets (steel, aluminum) are arranged in a substantially horizontal plane.

They comprise, according to Figure 2, unevennesses of relief, notably hollows 20, 21, 22, 23, respectively, whose concave faces are turned upward.

These hollows can impart stiffness by ensuring the surface evenness of the blades 1, 2, 3, 4; they can also function as containers allowing the retention of a reserve of water under the above-specified conditions.

The upper blade 1 is located above one or preferably two water distributors, 24, 25, respectively, which are connected to a water source from a local reserve or from the city water supply.

These distribution nozzles or spouts 24, 25 deliver, at a regulated flow rate, a flow of water which spreads over the upper blade 1.

The latter includes, as do all the other blades 2, 3, 4, one, preferably two, orifices or breaks in continuity 26, 27 which are successively arranged on the blades which are in a shelf-like arrangement; depending on manufacture, the perforations 26, 27 may be located one above the other. /11

Thus, the water which has been poured by the spouts 24 and 25 and which spreads over the entire blade 1 falls, drop by drop, through the orifices 26 and 27, falling on the lower blade 2 substantially in proximity to the edges of the orifices which correspond to the blade 2, namely the perforations 26', 27'.

The blades are provided with an appropriate coating, such as a paint with surfactant effect, to adjust the solid/liquid surface tension between the blade and the film of water which spreads over each blade.

Water from the spouts 24 and 25 flows substantially continuously; as a result the surfaces of the successive blades 2, 3, 4 are successively covered with a superficial film which fills the capacity 22, 23 and forms a reservoir which is continuously maintained by arrivals from above through the spouts 24 and 25 until all the blades are covered with a film of water in the liquid state.

When all the blades have been coated with this film, the overflow which continues to pour from the upper blade down can then be received by the lower vat 28 and flow out at 29.

One can see, that, under these conditions, one continuously maintains, when the internal temperature is positive, a source of humidity along a large developed surface area corresponding to the total of the surface areas of the superposed blades or vanes 1, 2, 3, 4.

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The air which is caused to circulate by the blower 19 passes through the bottom 9 of the corresponding wall of the enclosure and it spreads over the entire internal capacity of the enclosure, passing over and between the successive blades and consequently lap against the film of humidity which has been retained and absorbed on the surface of each blade and consequently becoming recharged with humidity; this air then laps against the products which are stored on the brackets or shelves and maintain them in a humid ambience and consequently renewing the superficial humidity on the products each time when the internal changes in the product would entail a risk of drying at the surface with formation of a crust; thus, the air which is replaced at the surface of the products constitutes a vector of humidity which is superficially reincorporated in the products.

However, this humidity is defined with respect to the ambient temperature and it is not based on any contribution of heat; the vapor which has thus been placed in circulation is exactly adapted to the internal temperature.

And, if the coil becomes (possibly) a carrier of heat by the circulation of a heating fluid, no drying of the atmosphere occurs since the elevation of the temperature is accompanied by a greater production of humidity with an elevation of the dew point, consequently causing a greater flow rate of humidity, the level of humidity which remains inside the enclosure is consequently close to the saturation point.

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Figure 4 represents a variant in which the pouring of the overflow from one blade onto the lower blade does not occur through a perforation but as a result of the inclination of an end edge 30 of the blade 31, from which the overflow flows dropwise off the blade 33 toward the edge 32 which is located below and slightly raised.

In this manner, one achieves a circulation of the fluid, which maintains a film on the surface of the blade, along the arrows of the figure.

### Claims

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1. Device to ensure the humidification of the internal atmosphere of an enclosure (10) whose temperature can vary between a level corresponding to a freezing temperature of the products and a temperature above ambient temperature,

characterized in that it comprises horizontal blades (2,3,4) which are in a shelf-like arrangement along at least a part of one wall (9) of said enclosure (10), where the blades are associated with an external water supply source (24,25) which is capable of covering said blades with a layer of water in the liquid state, where each one of the blades comprises means to allow excess water on said blade to flow by gravity toward the blade immediately below.

2. Device according to Claim 1,

characterized in that the blades (1,2,3) consist of metal sheets, made of steel or aluminum.

3. Device according to one of Claims 1 or 2,

characterized in that the blades (1,2,3,4) constitute the heat and/or cold dispersion vanes and they are associated with a coil (8) for the circulation of a heating or cooling fluid which is connected to a heat source and/or cold.

4. Device according to one of Claims 1, 2 or 2 [sic; 3],

characterized in that the blades are substantially flat and they are arranged in a substantially horizontal plane, and each blade comprises, in a point-shaped manner, a zone of discontinuity in surface evenness, where this zone constitutes the means which allows excess water to flow by gravity onto the lower blade.

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5. Device according to Claim 4,

characterized in that the zone of discontinuity consists of a break in continuity, such as a perforation or a recess (26,26') in the surface of the blade, which is capable of causing the water to flow down.

6. Device according to Claim 4,

characterized in that said zone of discontinuity consists of a downward inclinate or slope (30) imparted to an edge of said blade by causing the excess humidity to flow out by gravity, toward the lower blade.

7. Device according to one of Claims 1-6,  
characterized in that said blades comprise a surface treatment which is capable of adjusting the liquid-solid surface tension between the water which has flowed and the wall of the blade constituting the support receiving the circulating water.

8. Device according to one of Claims 1-7,  
characterized in that it consists of a horizontal superposition of blades in a shelf-like arrangement, in proximity of the wall constituting the vertical bottom of the enclosure, and in that the so constituted device is associated with circulation causing means (19) for the ambient air, which are such that the air, regularly and constantly, laps against the walls of said blades receiving the layer of water, while entraining the water into the atmosphere as it evaporates.

9. Device according to one of Claims 1-8,  
characterized in that it is associated with a water source which is connected to an external supply, for example to the water supply of the city, and led to an outflow vat (24) which is arranged above the upper blade.

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10. Device according to one of Claims 1-8,  
characterized in that it comprises, in the lower position, a receiving vat (28) which is located directly below the lowest blade and capable of receiving the overflow of the device.

11. Device according to Claim 9,  
characterized in that the upper supply source comprises an electro-valve with programmed action and associated with essential control means associated with a probe capable of continuously measuring the hygrometry of the internal atmosphere of the enclosure and of sending orders to open the electro-valve as a function of the humidity requirements so observed.

12. Device according to one of Claims 1-11,  
characterized in that said blades include, on their horizontal wall, an unevenness of relief (22,23), where the concave face is turned upward, and the hollow areas are capable of forming reserves of water on the surface of said blades.

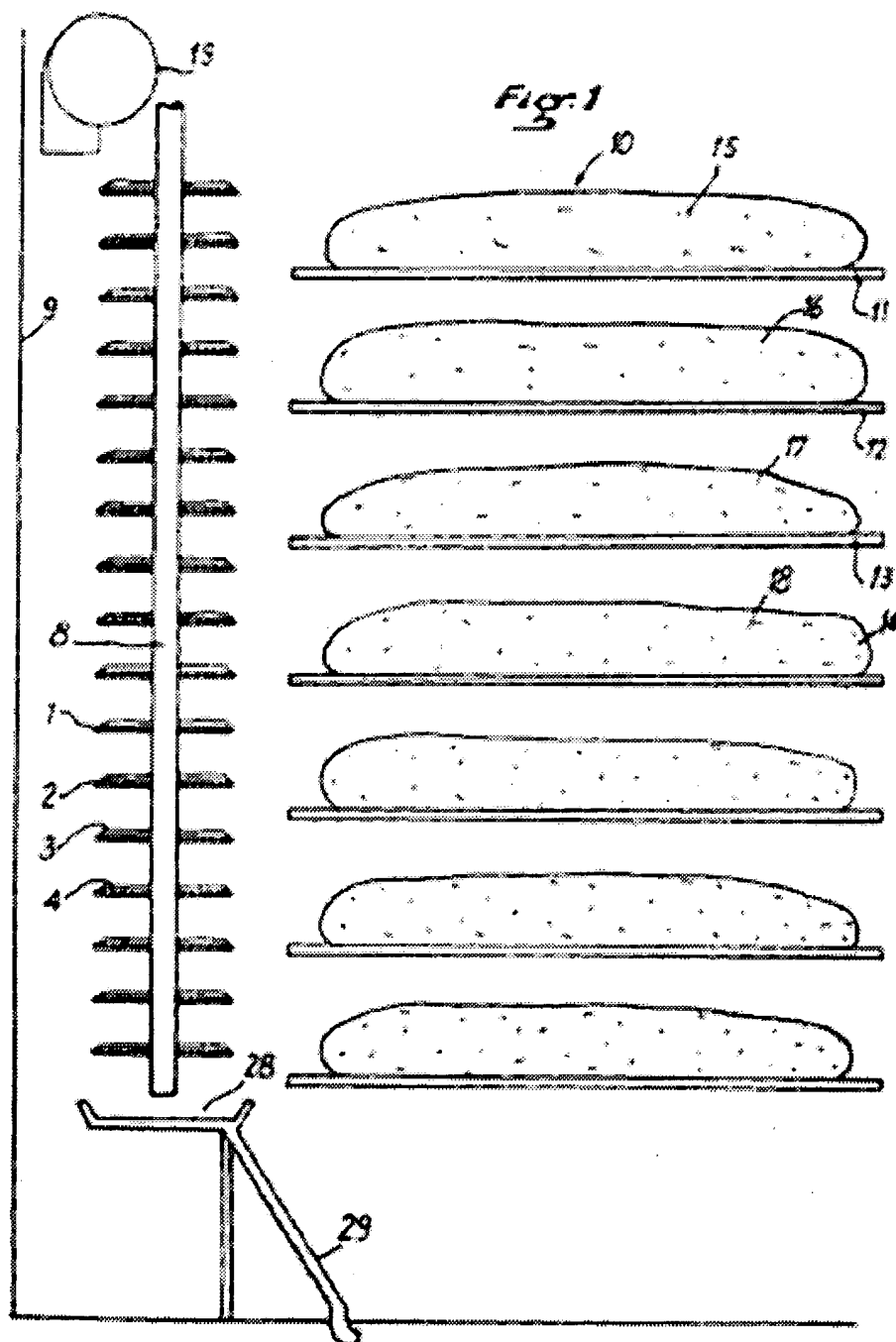
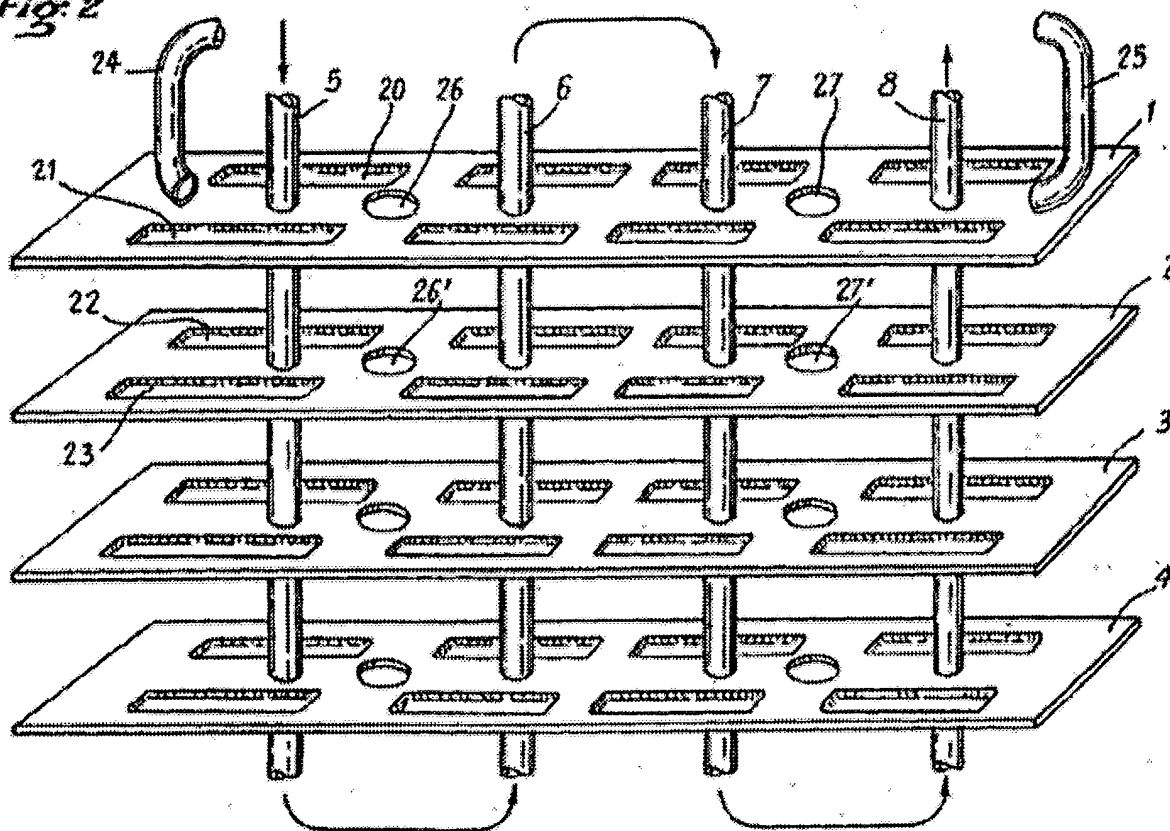
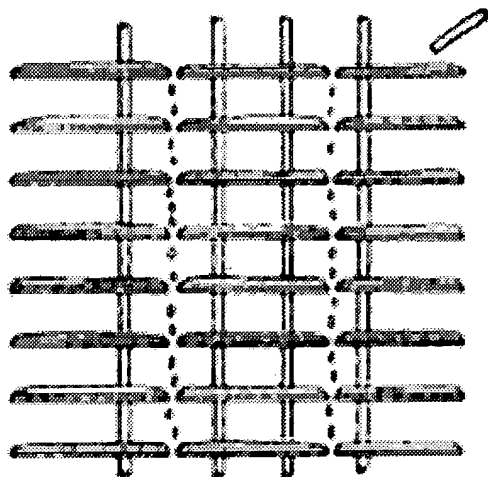
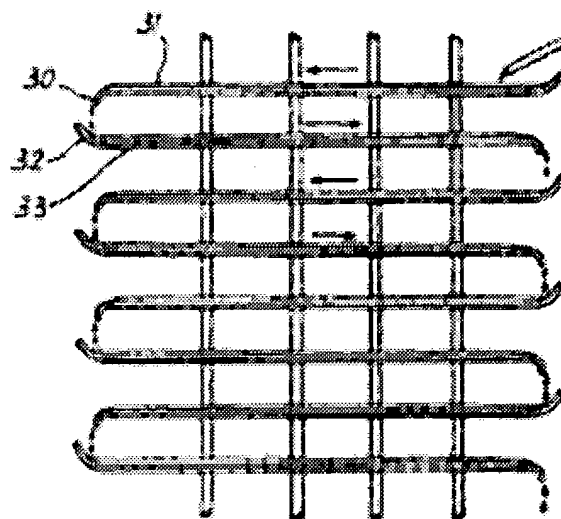


Fig. 2



*Fig. 3**Fig. 4*

Continuation of Attachment(s) 6). Other: Translation of French patent 2 599 344.